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(54) Abstract Title
**Monitoring waste on a spinning preparation machine**

(57) In a spinning preparatory machine, for example, a cleaner, opener, carding machine or the like, for detecting separated waste that emerges from separating elements and is collected in a collecting device 17, there is provided an optical measuring device that monitors the waste.

To enable the proportion of good fibre in the waste to be detected and information about the composition of the waste to be obtained, an electronic camera 41 which is connected to an electronic evaluating device (image-processing unit) is associated with the waste-collecting device 17.

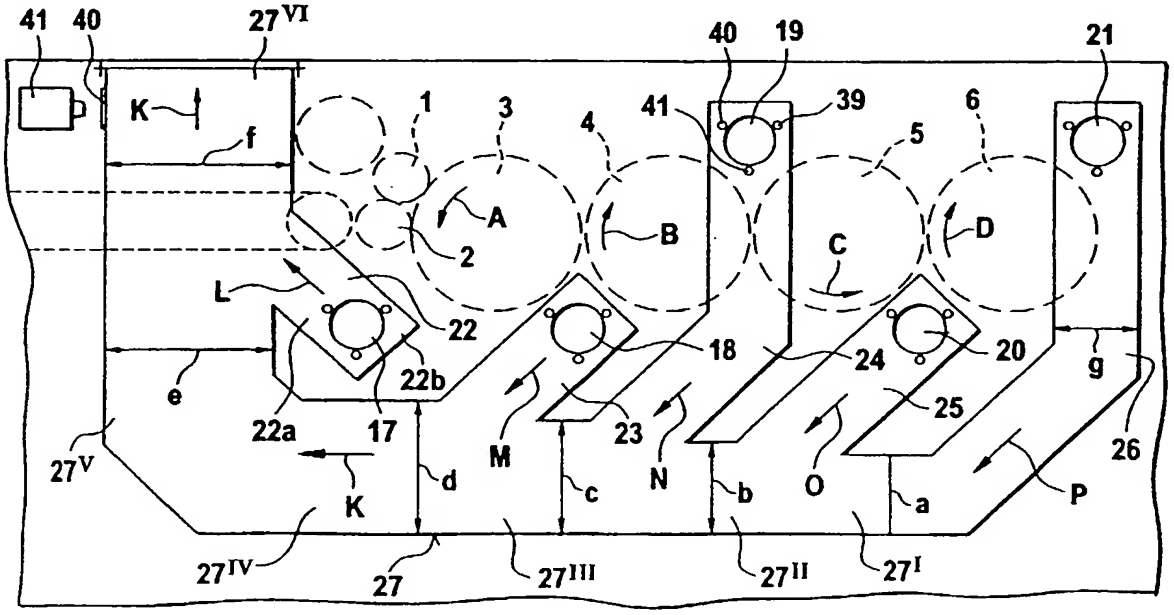


Fig. 1b

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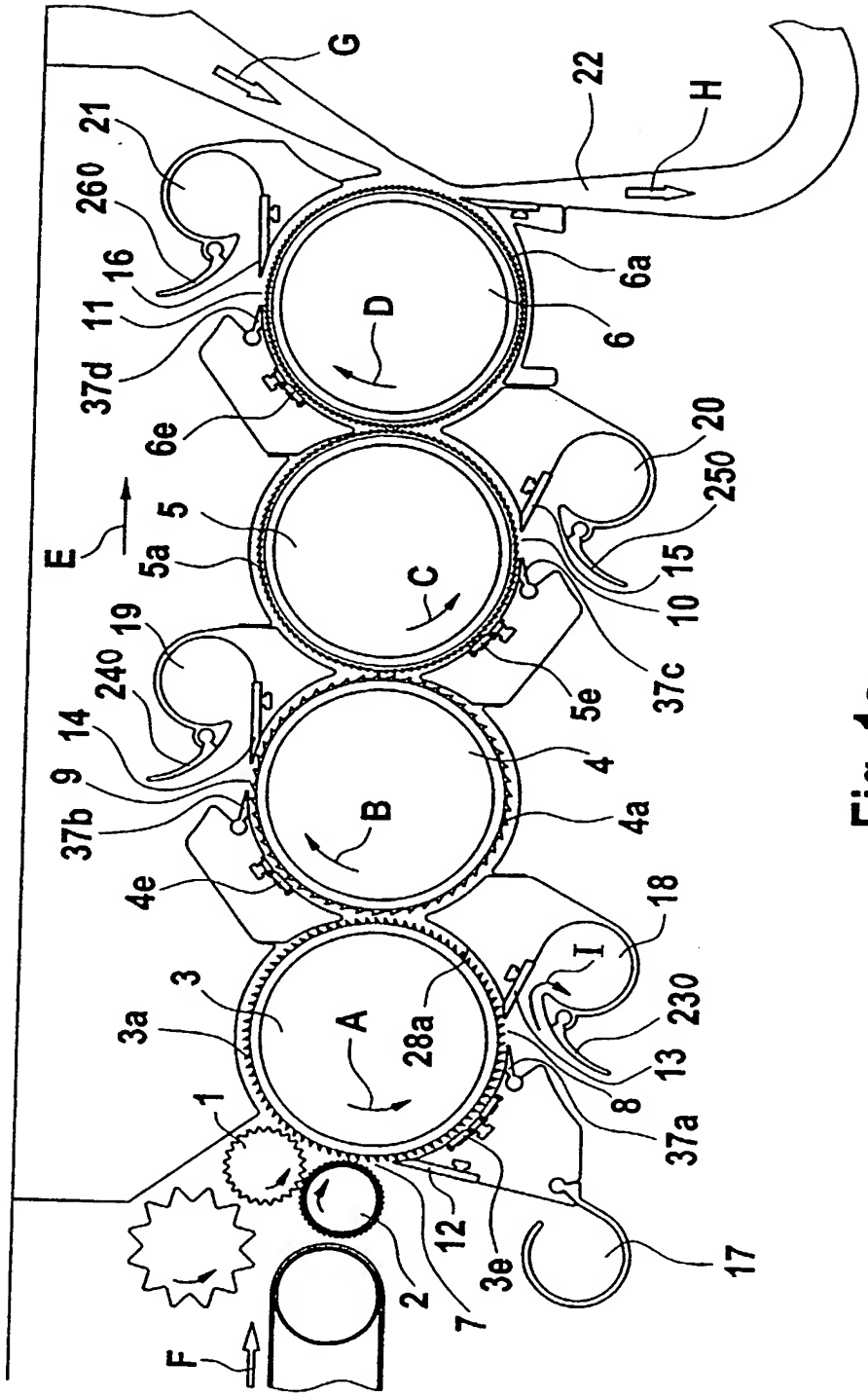
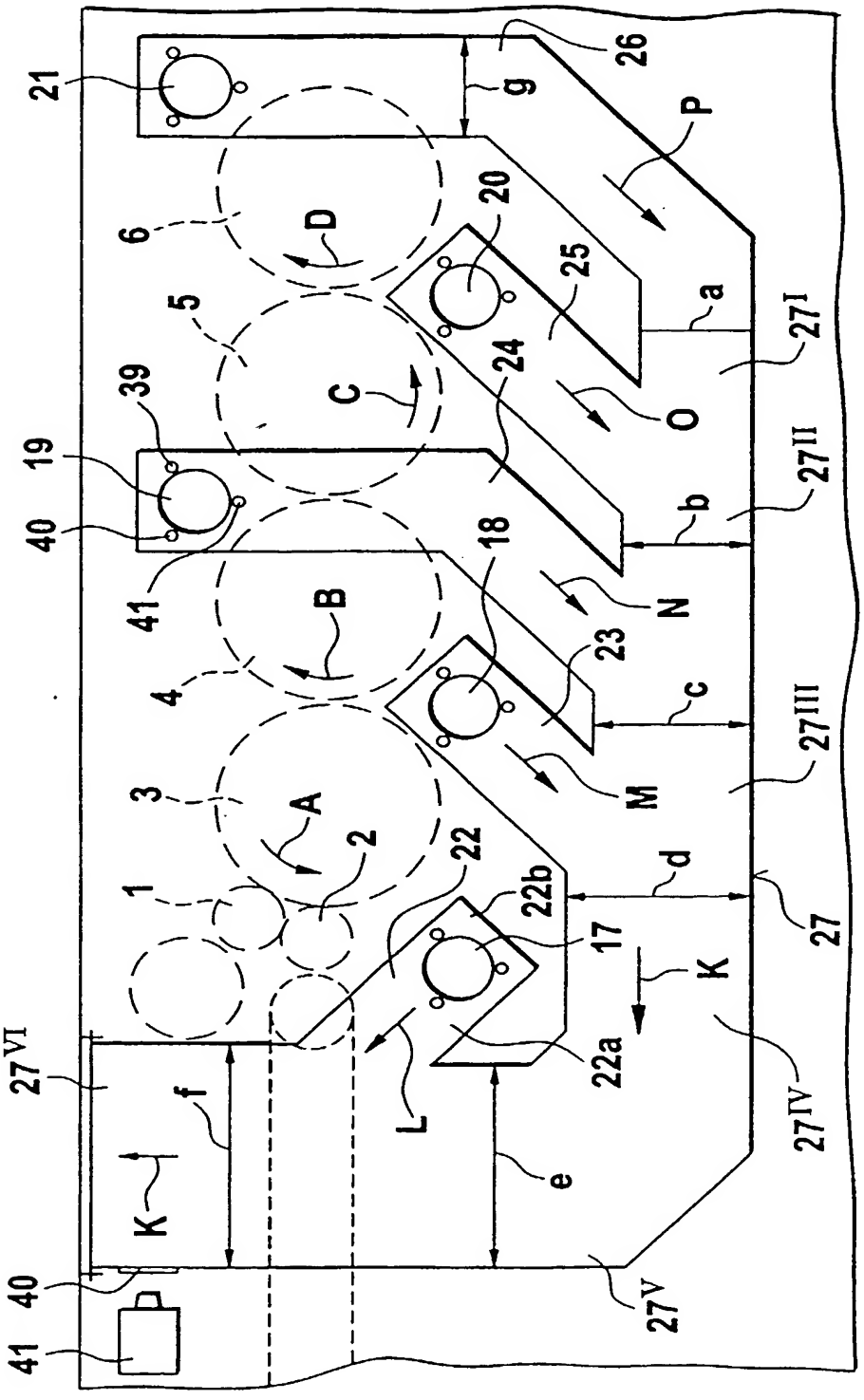

G
22
H
21
260
16
11
37d
6e
D
6
6a
E
5
5a
C
20
250
15
10
37c
5e
19
240
14
9
37b
B
4
4a
4e
18
I
3
3a
A
28a
230
13
8
37a
1
12
3e
17
2
7
F

Fig. 1a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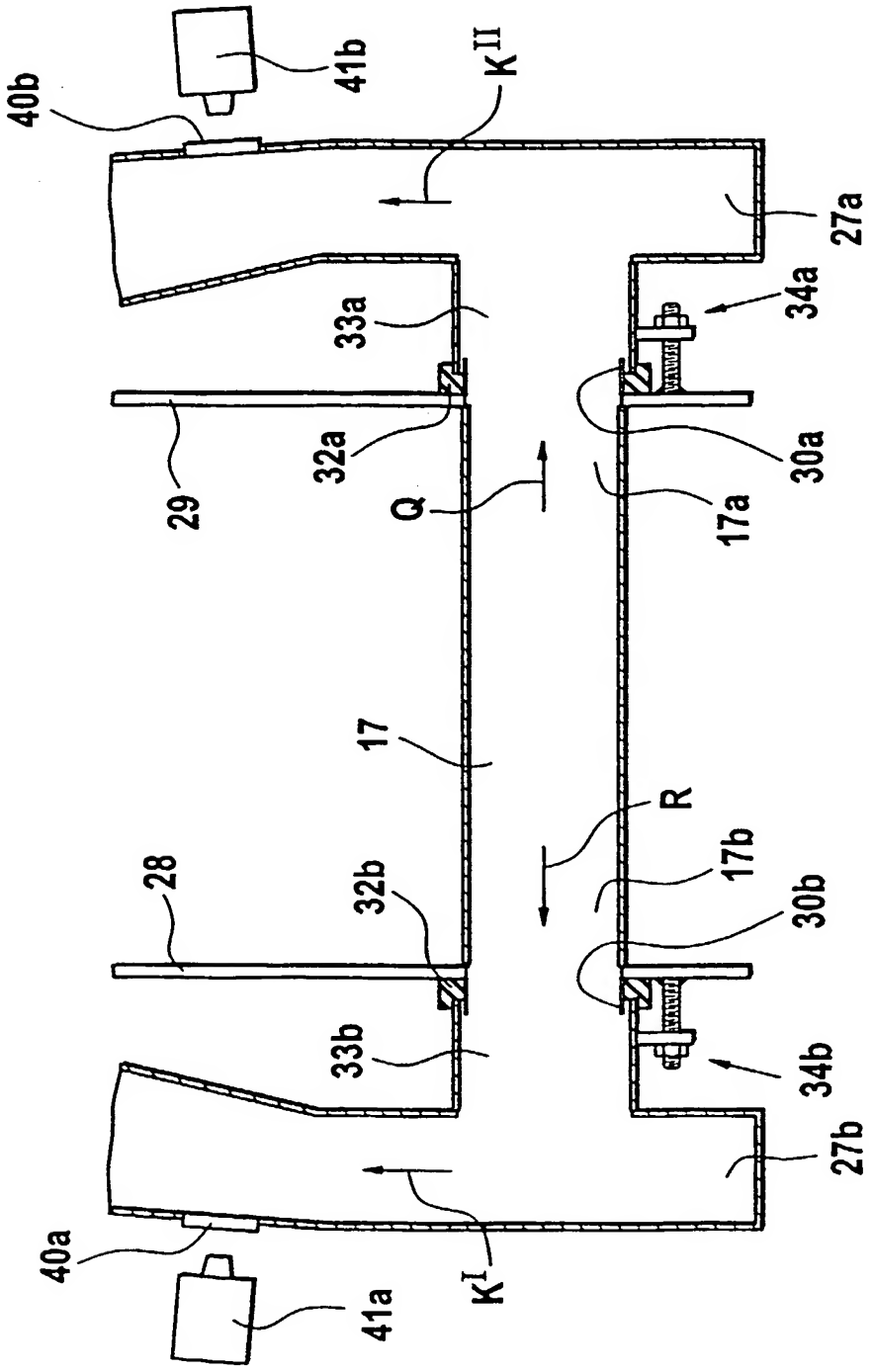
g
P
6
D
20
25
a
27I
5
C
24
O
39
19
40
41
B
18
N
27II
b
4
23
c
27III
M
3
A
2
1
22
22b
d
27
17
K
22a
L
27IV
27VI
f
K
e
40
41
27V

Fig. 1b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41b
K^II
27a
34a
33a
32a
29
Q
30a
17a
17
R
17b
28
32b
30b
33b
34b
27b
40a
41a
K^I

Fig. 2

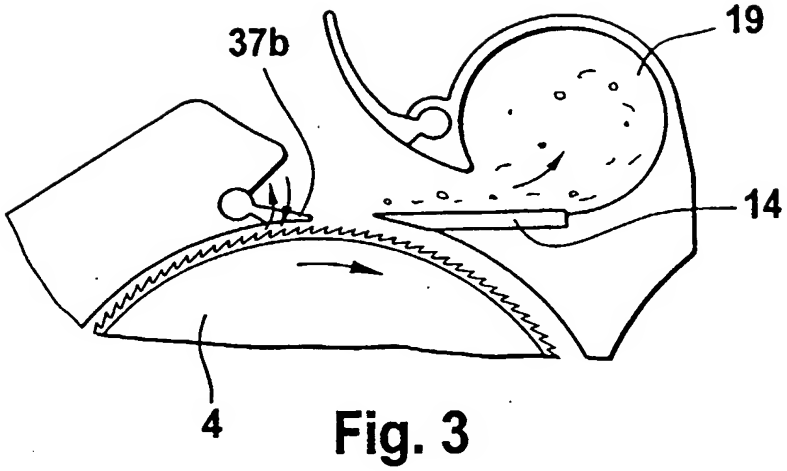
37b
19
14
4

Fig. 3

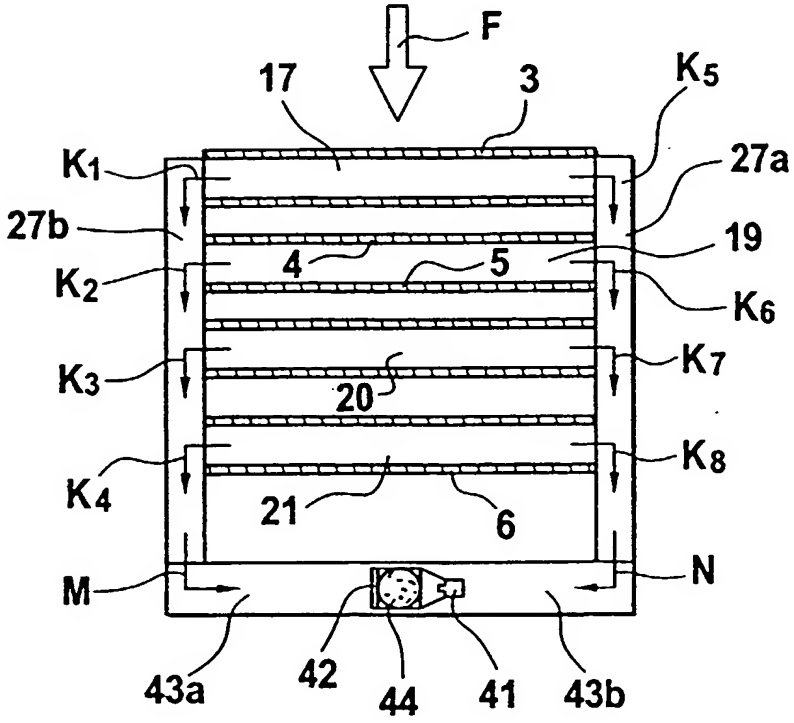
F
17
3
K5
K1
27a
27b
19
4
5
K2
K6
K3
K7
20
K8
K4
21
6
M
N
43a
42
44
41
43b

Fig. 4

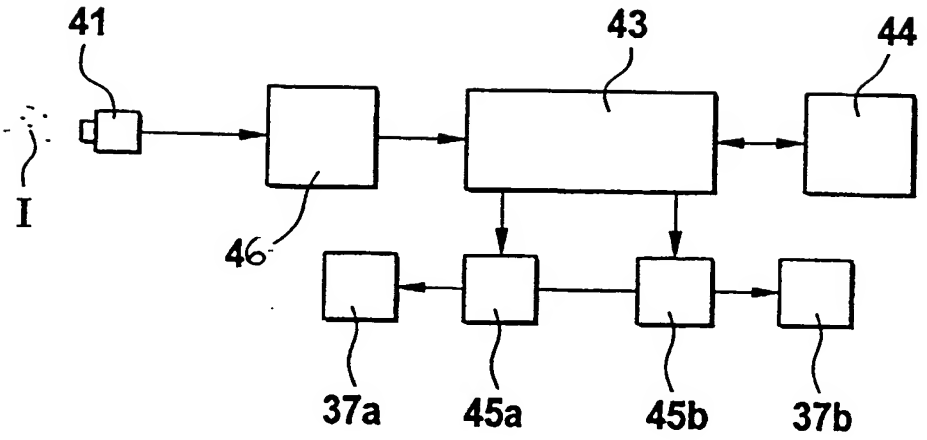


Fig. 5

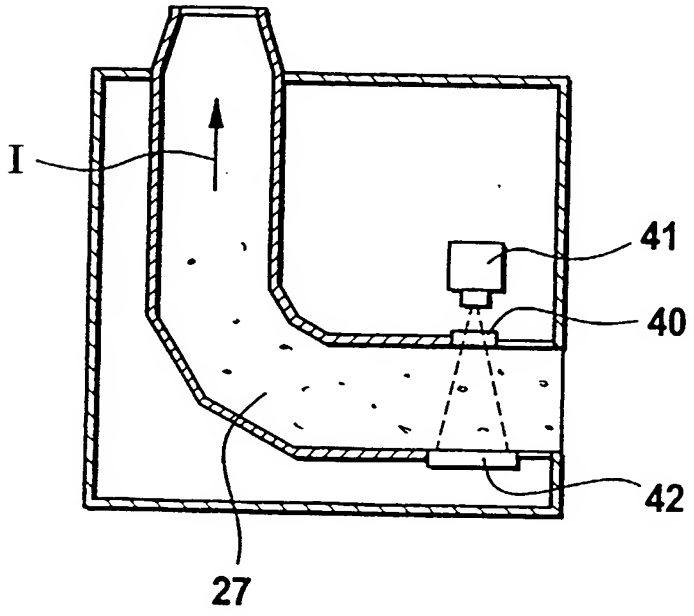


Fig. 6

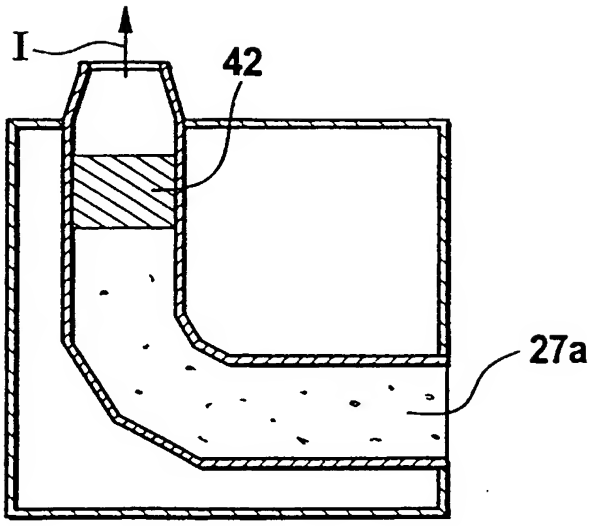


Fig. 7b

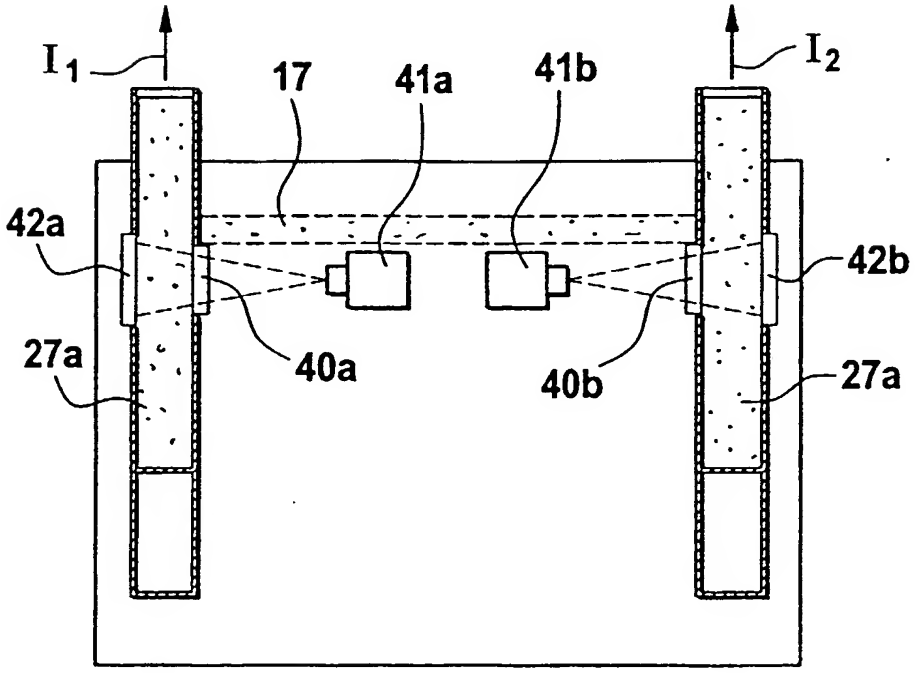


Fig. 7a

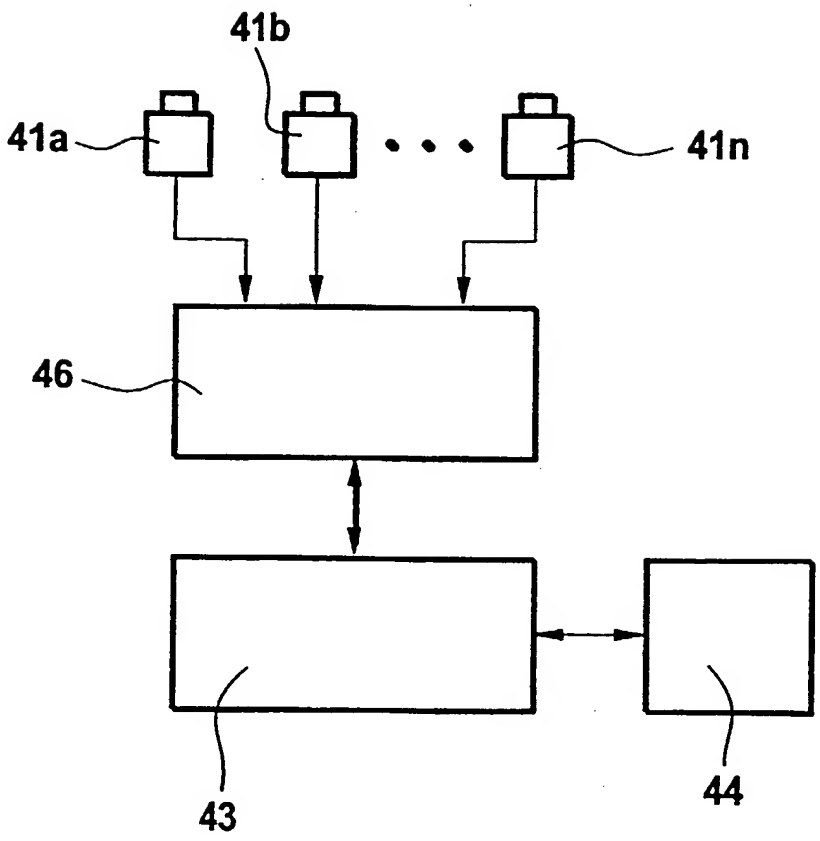


Fig. 8

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# Apparatus on a spinning preparation machine

The invention relates to an apparatus on a spinning preparatory machine, for example, a cleaner, opener, carding machine or similar, for detecting separated waste that emerges from separating elements and is collected in a collecting device.

In a known device, the apparatus includes an optical measuring device, which monitors the waste for the impurity content thereof. EP 0 399 315 describes a device in which the beating pins of a cleaning roller convey the fibre flocks over cleaning bars, which are adjustable in such a way that the intensity of cleaning can be changed. Beneath the cleaning bars, a brightness sensor measures brightness as a measure of the impurity content of the separated waste, which has been discharged through the cleaning bars and is collected in a funnel-like collecting device. At preset intervals, the waste is sucked off via a suction transport device that is arranged at the lower end of the collecting device. The brightness of the separated waste measured by the brightness sensor is entered in the form of a signal into a control means and displayed on a display. It is a disadvantage that the sensor is used only for detecting the impurity content, and there is no detection of the proportion of good fibre. In addition, it is inconvenient that the sensor is only able to determine differences in brightness, so that no information can be obtained about the composition of the waste, in particular

about the type of constituents of the impurity content.

It is an aim of the invention to produce an apparatus of the kind described in the introduction, which avoids or mitigates the said disadvantages, which in particular allows the proportion of good fibre in the waste to be detected and enables information to be obtained about the composition of the waste.

The invention provides an apparatus on a spinning preparatory machine for detecting separated waste that emerges from separating elements and is collected in a collecting device, wherein there is associated with the waste-collecting device an electronic camera which is connected to an electronic evaluating device (image-processing unit).

The features according to the invention enable the proportion of good fibre in the waste to be detected automatically and information to be obtained about the composition of the waste. The electronic camera and the linked image evaluation system enable the proportion of good fibre in the waste to be identified accurately, this knowledge being used to adjust the separating elements. In addition, the electronic image evaluation allows reliable information to be obtained about the composition of the waste (for example, about neps, bits of husk, trash, good fibres), enabling conclusions to be drawn about the work of the machine and leading to appropriate adjustment of the machine elements and working elements. As a result, the separated waste is assessed continuously, objectively and hence independently of personnel. On the basis of corresponding

sensing and evaluating techniques, it is possible to obtain information about the nature of the waste. In particular, it is possible to determine the proportion of good fibre that has been separated with the waste and, when necessary, to influence it. Depending on the results obtained, existing machine elements can be adjusted in such a way that they automatically produce a previously determined and desired waste composition. Information can also be obtained about the sizes of separated impurities. Information about the consistency and the amount of waste can be rendered directly readable on the display of the control panel of the machine, and, when necessary, can be relayed to higher-level data acquisition systems or similar systems.

Detection and assessment of the waste may be effected automatically. Detection and assessment of the waste may be effected continuously. Advantageously, the measurement results of the evaluating device are compared with preset variables. Advantageously, on departure from preset variables, the waste separation is arranged to be changed. Advantageously at least one optoelectronic camera is integrated in the suction channels through which the separated material is sucked off. Advantageously, more than one electronic evaluating device is present. Advantageously, more than one optoelectronic camera is connected to evaluating devices. Advantageously, the evaluated measurement results in respect of amount and consistency of the separations are compared with preset values and are used for automatic change of machine elements influencing the separation. Preferably, at least

one evaluating device is connected to the associated machine control system. Advantageously, the evaluated measurement results of the separation processes are displayed on the operating and display unit of the machine. Advantageously, the evaluated measurement results of the separation processes are relayed to other systems, possibly higher-level and central systems. Advantageously, at least two optoelectronic cameras are associated with each machine. Advantageously, at least one optoelectronic camera is arranged on each side of a machine. Advantageously, the at least two electronic cameras are connected to a central evaluating device. Advantageously, the camera is a matrix camera. Advantageously, different light sources are provided. Advantageously, light sources of different colours are provided. The different colours may be red light and infrared light. Advantageously, at least one reflected light source and/or one transmitted light source are/is provided. Advantageously, the size of the suction pipeline is matched to the depth of field range of the at least one camera. Advantageously, the evaluated measurement results are used for adjustment of at least one guide blade associated with the roller. Advantageously, the evaluated measurement results are used to adjust at least one separating blade associated with the roller. Advantageously, at least one electronic evaluating device (image-processing unit) is connected to an electronic open-loop and closed-loop control device, for example, a microcomputer. Advantageously, the machine elements such as guide blades, separating blades and the like are

automatically adjustable in dependence on the evaluated measurement results. Advantageously, the cleaning capacity of the machine is alterable in dependence on the evaluated measurement results. Advantageously, the nature of the waste (amount, composition) is alterable in dependence on the evaluated measurement results. Advantageously, at least one separate camera is associated with each suction point or each guide blade. Advantageously, the camera is associated with a central waste-collecting channel. Preferably, a window for the camera is present in each waste-collecting channel. Preferably, a window for an illuminating means is present in each waste-collecting channel. Advantageously, the evaluated measurement results are used to determine the weight of the separations. Advantageously, the evaluated measurement results are used to determine the ratio of the proportion of good fibre to the proportion of dirt. Advantageously, the evaluated measurement results are used to determine the weight of specific types of dirt particles. Advantageously, limit values for specific parameters are provided, for example, weight of the separated waste and particle amount. Advantageously, the evaluated measurement results are used to assess the quality of the fibre material to be processed. Preferably, a machine is connected to a central evaluating device to which more than one camera is attached. Digital image processing may be used in the evaluating device. The electronic open-loop and closed-loop control device, for example, a computer, may have a memory for comparative data. Preferably, the evaluating device is connected to a higher-level

electronic monitoring system for example, KIT. Advantageously, the measured values of the camera are convertible to electrical signals. Advantageously, the evaluated measurement results are used in an open-loop and closed-loop control circuit to optimise cleaning of the fibre material. Advantageously, the nature of the waste (amount, composition) is alterable in dependence on the evaluated measurement results. Advantageously, images of the waste are taken by means of digitised photodiodes. Advantageously, the evaluation of the digital image information is effected by means of image analysis software.

The invention also provides an apparatus on a spinning preparatory machine, for example, a cleaner, opener, carding machine or similar, for detecting separated waste that emerges from separating elements and is collected in a collecting device, in which apparatus an optical measuring device that monitors the waste is provided, wherein an electronic camera which is connected to an electronic evaluating device (image-processing unit) is associated with the waste-collecting device.

Moreover, the invention provides a method of opening and cleaning fibre material, comprising transporting the fibre about two or more rollers in opening and cleaning relationship, separating waste from the fibre material at at least one separation gap, and examining the separated waste by means of a camera.

Certain embodiments of the invention will now be described in greater detail with reference to the accompanying drawings, in which:

Fig. 1a is a diagrammatic side view of a

cross-section through a cleaning machine having several suction hoods for waste;

Fig. 1b is a diagrammatic side view of the cleaning machine of Fig. 1a in which the apparatus according to the invention can be seen;

Fig. 2 is a front view of the apparatus shown in Fig. 1b;

Fig. 3 shows a separation point for waste with an adjustable guide blade;

Fig. 4 is a plan view of the apparatus shown in Fig. 1b;

Fig. 5 is a block diagram of an electronic open-loop and closed-loop control system with attached camera, evaluating device, operating and display device and actuating device for guide blades;

Fig. 6 shows a waste-collecting channel with window, camera and illuminating means;

Fig. 7a shows a suction channel with respective window, camera and illuminating means on each side of a cleaning machine;

Fig. 7b is a side view of the apparatus shown in Fig. 7a showing the arrangement of the illuminating means; and

Fig. 8 is a block diagram in which a central (common) evaluating device is present between the electronic open-loop and closed-loop control system and a plurality of cameras.

Referring to Fig. 1a, the fibre material to be cleaned (arrow F), cotton in particular, is fed in flock form to a cleaning device, (for example a CVT 4 cleaning device made by Trützschler GmbH & Co. KG), arranged in a closed housing. This is effected, for example, by a feed chute (not shown), a conveyor belt or the like. The lap is fed by means of two feed rollers 1, 2, by being gripped therebetween, to a pin roller 3, which is rotatably mounted in the housing and turns anti-clockwise (arrow A). Downstream of the pin roller 3 there is arranged a clothed roller 4, which is covered with a saw-toothed clothing. The roller 3 has a circumferential speed of about 10 to 21 m/sec. The roller 4 has a circumferential speed of about 15 to 25 m/sec. Two further saw-toothed rollers 5 and 6 are arranged downstream of the rollers 3 and 4, the directions of rotation thereof being denoted by the letters C and D respectively. The roller 5 has a higher circumferential speed than roller 4 and the roller 6 has a higher circumferential speed than roller 5. The rollers 3 to 6 have a diameter of about 150 to 300 mm. The pin roller 3 is enclosed by the housing. A separating opening 7 for the discharge of impurities in the fibre is associated with the pin roller 3, the size of the opening being adapted or being adaptable to the degree of contamination of the cotton. A separating edge 12, for example, a blade, is associated with the separating opening 7. Further separating opening 8 and a separating edge 13 are present in the direction of arrow A adjacent to the roller 3. A separating opening 9 and a separating edge 14 are associated with the saw-toothed roller 4, a

separating opening 10 and a separating edge 15 are associated with the saw-toothed roller 5 and a separating opening 11 and a separating edge 16 are associated with the saw-toothed roller 6. A respective suction hood 17 to 21 is associated with each separating blade 12 to 16. The letter E denotes the working direction of the cleaner.

Referring to Fig. 1b, a respective suction channel 22, 23, 24, 25, 26 is connected to each suction hood 17, 18, 19, 20, 21. The suction channels 22 to 26 are connected to a common suction channel 27. The rigid suction channels 22 to 26 and the suction channel 27 are constructed in one piece, for example, from sheet metal or plastics material. The length of the suction channels 22 to 26 is different, depending on the distance between the suction hoods 17 to 21 and the suction channel 27. The cross-sections $27^{I}$ to $27^{V}$ of the suction channel 27, seen in the direction of flow (arrow K), are indicated by a, b, c, d, each time after merger with a suction channel 22 to 26. The end $27^{VI}$ of the suction channel 27 is attached to a source of suction (not shown). The direction of flow within the suction channels 22 to 26 is indicted by arrows L to P.

The mode of operation is as follows: the lap consisting of fibre flocks (F) is fed by the feed rollers 1, 2, by being gripped therebetween, to the pin roller 3, which combs through the fibre material and carries off tufts of fibre on its pins. As the roller 3 passes the separating opening 7 and the separating edge 12, commensurate with the circumferential speed and curvature of this roller and of the size of the separating opening 7 matched to this first separating stage,

waste (short fibres and coarse impurities) and a certain (essentially undesirable) proportion of good fibre are flung by centrifugal force out of the fibre material remaining on the roller, and, after passing through the separating opening 7, enter a suction hood 17 (waste) in the housing. The fibre material pre-cleaned in this way is removed by the clothing tips of the clothed roller 4 from the first roller 3, in the process undergoing further opening. As the rollers 4, 5 and 6 pass the separating openings 9, 10 and 11 respectively, with separating edges 14, 15 and 16 respectively, further impurities are flung by centrifugal force out of the fibre web.

Arrows B, C and D denote the direction of rotation of the clothed rollers 4, 5 and 6 respectively. The reference numerals 17 to 21 denote suction devices for the impurities emerging from the separating openings 7 to 11. The direction of rotation A, B, C and D of respective adjacent rollers 3, 4, 5 and 6 is different. At the end of the last roller 6 there is a pneumatic suction device 22 for the cleaned fibre material (arrow H). The circumferential speed of the respective downstream roller is higher than the circumferential speed of the respective upstream roller. The reference numerals 230, 240, 250, 260 in Fig. 1a denote adjustable air guide elements that are mounted at the air intake opening of the suction hoods 17 to 21 and with which the amount of sucked in air is adjustable. A transparent pane 40 is mounted in the wall of the suction channel 27, so that it is possible to see into the channel 27 from the outside. A camera 41, which records the waste flowing through the suction

channel 27 past the pane 40, is associated outside the suction channel 27 with the pane 40.

Referring to Fig. 2, the suction hood 17 is arranged between the two frame walls 28, 29 (housing walls), a respective connector 30a, 30b being constructed outside the walls 28, 29 at the ends 17a, 17b of the suction hood 17 so that the suction hood 17 passes through two openings in the frame walls 28, 29. A respective resilient annular seal 32a, 32b, for example, of foamed material, is placed around the connector 30a, 30b. The one end region 22a of the suction channel 22 opens into the suction channel 27a (see Fig. 1b), the other end region 22b of the suction channel 22 opens into the suction channel 27b. The reference numerals 34a, 34b denote fixing elements, for example, screw connections. The ends of the suction channels 27a, 27b are connected to a common suction channel 44 (see Fig. 4), which is connected to a source of suction (not shown). The connection of the suction channel 22a to the suction hood 17 and to the suction channel 27a corresponds to the connection of the suction channel 22b to the suction hood 17 and the suction channel 27b. A respective transparent pane 40a, 40b is mounted on the outside of the suction channels 27a, 27b; associated with the pane outside the suction channels 27a, 27b is a respective camera 41a, 41b, which detects the waste. The arrows Q and R denote the direction of flow of the suction currents inside the suction hood 17. The letter I represents the separated material.

The cleaning device illustrated in Figures 1a, 1b and 2 has devices with which the amount and to

an extent also the nature of the waste to be separated (foreign bodies, trash, neps etc) can be adjusted or influenced. These devices are in the form of guide blades 37a, 37b, 37c, 37d, adjustable by motor, which are arranged upstream of the separating blades in the region of the opening and cleaning rollers 3 to 6. The angular position of these blades 37 can be used to influence the amount and to a certain extent also the nature of the separations I as may be seen more clearly with reference to Fig. 3. It is the case here that a large opening angle results in relatively large separations I and a small opening angle gives correspondingly fewer separations. Fixing the desired separations I simultaneously determines quite specifically the cleaning action of the machine on the good material. Since the kind of separations I generally involve also the separation of "good" fibre material as well, in practice it is a matter of finding an acceptable compromise. That is, as much "poor material" as possible is eliminated accompanied at the same time by a minimum amount of separated good fibre. To assess the separated waste I and hence be able to make the possible adjustments, the waste I is separated, collected and finally visually assessed in the manner according to the invention.

Referring to Fig. 4, the waste I from the individual separating points is combined on each side of the machine and is sucked off continuously by means of partial vacuum and conveyed to a central filtering and separating installation 44. In accordance with the invention, an optoelectronic camera system 41 with suitable illuminating means 42 and evaluating unit is

integrated in the "waste-collecting channel". The system is arranged in such way that it is capable of recording all fibres, foreign bodies or other parts streaming past it inside the channel 44. Moreover, it is constructed to be able to distinguish individual materials and to provide information relating to the amount and size thereof. Depending on corresponding programmed values, the machine assemblies (for example, the guide blades 37) influencing the waste I, will then automatically be adjusted until the desired quality of waste is achieved. The letters $K_1$ to $K_8$, M and N denote suction air currents.

Referring to Fig. 5, the camera 41, for example a CCD camera, an operating and display device 44 and two blade-adjusting devices 45a, 45b for adjusting the guide blades 37a and 37b respectively are connected up to an electronic open-loop and closed loop control system 43 (machine control system), for example, a microcomputer.

Figs 6 and 7a, 7b illustrate possible arrangements of the detecting devices within a cleaning machine. In the embodiment of Fig. 6, illuminating means 42 is provided underneath the channel 27, and a camera views the fibre in the channel through a transparent pane 40 opposed to the illuminating means. In Fig. 7a, fibre material is examined in vertical channel portions 27a, 27b by means of respective illuminating means 42a, 42b, panes 40a, 40b and cameras 41a, 41b. If several adjustable elements determining the quality of the waste are present in a machine, then these generally have different basic settings. When using a central waste-detection

device, the elements are changed, for example, in proportion to this basic setting. In principle, however, other alteration conditions are possible in the device according to the invention (for example, specific to the cleaning roller). These can be entered (manually or via a communication network), stored and re-used as necessary at a later time. Manual change of all these values is also possible.

The following advantages are obtained in this manner:

1. Assessment of the separated waste is effected continuously, objectively and consequently independently of operating personnel.

2. On the basis of corresponding sensing and evaluating techniques it is possible to obtain information about the nature of the waste. It is possible, for example, to determine and, as necessary, influence the proportion of good fibre that has been separated with the waste.

3. Depending on the results obtained, existing machine elements (for example, guide vanes, blades) can be adjusted so that a pre-determined and desired waste composition is automatically obtained.

4. In addition, information about the size of separated impurities can be obtained.

5. Information about the consistency and the amount of waste is directly readable on the display 44 of the control panel of the machine

and can be relayed as necessary to higher-level data acquisition systems or similar systems.

If several detection devices are used per machine or similar, especially, for example, per separation point, as shown in Fig. 8 it is advantageous to use a central evaluating device 46 for several cameras 41a, 41b to 41n, which provides *inter alia* a cost-optimised solution. Furthermore, only one communication connection with the machine control system 43 is needed, and many necessary functions can be used jointly by the cameras 41a to 41n and for evaluation.

In Figs. 6, 7a and 7b, I, $I_1$ and $I_2$ denote the waste.

Influencing of separating elements in the manner according to the invention in dependence on the determined consistency or quality of the waste can be applied in all machines that have corresponding devices, including carding machines in particular.

With appropriate programmed values, the system can also provide relatively good data about the weight of the separated material. Since the output is generally also known, it is therefore possible to provide information about the ratio of good material to separated material. Since the nature and size of the separated particles are determined, corresponding data can be produced from weights that have been empirically determined previously.

By way of example, for all separated particles there is a correlation between number, type, size and weight. When the latter correlation is

determined and preset, then from the information obtained according to the invention about type and number, it is possible to obtain corresponding weight data with satisfactory accuracy.

If these values are additionally related to time, then information is obtained, for example, about how many grammes per hour are separated. If known values about production output (kg/h) are also included, and these are set in proportion to the waste values, then it is possible to obtain a percentage value for the separated waste (for example, 3% waste has been separated).

It is a further advantage that use of the apparatus according to the invention enables limit values for specific parameters can be preset.

According to a further example, a warning is given when the separated amount is greater than x grammes.

Furthermore, material-specific statistics generated automatically like this can be controlled, and it is possible to establish which materials have what number of impurities. A client is therefore given optimum assistance, for example, in selecting the correct base material for specific products.

## Claims

1. An apparatus on a spinning preparatory machine for detecting separated waste that emerges from separating elements and is collected in a collecting device, wherein there is associated with the waste-collecting device an electronic camera which is connected to an electronic evaluating device (image-processing unit).
2. An apparatus according to claim 1, in which detection and assessment of the waste can be effected automatically.
3. An apparatus according to claim 1 or claim 2, in which detection and assessment of the waste can be effected continuously.
4. An apparatus according to any one of claims 1 to 3, in which the arrangement is such that the measurement results of the evaluating device are compared with preset variables.
5. An apparatus according to any one of claims 1 to 4, in which the arrangement is such that on departure from preset variables, the waste separation is arranged to be changed.
6. An apparatus according to claim 1, in which the collecting device comprises a suction channel through which in use the waste is sucked, the electronic camera being arranged to detect waste in the channel.
7. An apparatus according to claim 6, in which at least one optoelectronic camera is integrated in the suction channel through which the separated material is sucked off.
8. An apparatus according to claim 7, which comprises two or more suction channels, the

apparatus further comprising a respective optoelectronic camera associated with at least two suction channels.

9. An apparatus according to any one of claims 1 to 7, in which more than one optoelectronic camera is connected to the evaluating device.

10. An apparatus according to any one of claims 1 to 9, wherein more than one electronic evaluating device is present.

11. An apparatus according to any one of claims 1 to 10, in which the arrangement is such that the evaluated measurement results in respect of amount and consistency of the separations are compared with preset values and are used for automatic adjustment of machine elements influencing the separation.

12. An apparatus according to any one of claims 1 to 11, in which at least one evaluating device is connected to the machine control system of the associated spinning preparatory machine.

13. An apparatus according to claim 12, in which the evaluated measurement results of the separation processes are displayed on the operating and display unit of the machine.

14. An apparatus according to any one of claims 1 to 13, in which the evaluated measurement results of the separation processes are relayed to other systems, for example, higher-level and central systems.

15. An apparatus according to any one of claims 1 to 14, in which at least two optoelectronic cameras are associated with each machine.

16. An apparatus according to claim 15, in which at least one optoelectronic camera is arranged on each side of a machine.

17. An apparatus according to claim 15 or claim 16, in which at least two electronic cameras are connected to a central evaluating device.

18. An apparatus according to any one of claims 1 to 17, in which the camera is a matrix camera.

19. An apparatus according to any one of claims 1 to 18, in which a light source is provided for illuminating the part of the collection device that is monitored by the camera.

20. An apparatus according to claim 19, in which two or more different light sources are provided.

21. An apparatus according to claim 20, in which light sources of different colours are provided.

22. An apparatus according to claim 20 or claim 21, comprising a red light source and an infrared light source.

23. An apparatus according to any one of claims 19 to 22, in which at least one reflected light source is provided.

24. An apparatus according to any one of claims 19 to 23, in which at least one transmitted light source is provided.

25. An apparatus according to any one of claims 1 to 24, in which the diameter of the collection device is matched to the depth of focus range of at least one camera.

26. An apparatus according to any one of claims 1 to 25, in which the arrangement is such that the evaluated measurement results are used for adjustment of at least one guide blade associated with a roller of the machine.

27. An apparatus according to any one of claims 1 to 26, in which the arrangement is such that the evaluated measurement results can be used to

adjust at least one separating blade associated with a roller of the machine.

28. An apparatus according to claim 26 or claim 27, in which the guide blades and/or separating blades are automatically adjustable in dependence on the evaluated measurement results.

29. An apparatus according to any one of claims 1 to 28, in which at least one electronic evaluating device (image-processing unit) is connected to an electronic open-loop and closed-loop control device, for example, a microcomputer.

30. An apparatus according to any one of claims 1 to 29, in which the cleaning capacity of the machine is alterable in dependence on the evaluated measurement results.

31. An apparatus according to any one of claims 1 to 30, in which the arrangement is such that the nature of the waste stream, for example, is alterable in dependence on the evaluated measurement results.

32. An apparatus according to any one of claims 1 to 31, in which at least one separate camera is associated with each suction point or each guide blade of the machine.

33. An apparatus according to any one of claims 1 to 32, which comprises a central waste-collecting channel, there being a camera associated with the central waste-collecting channel.

34. An apparatus according to any one of claims 1 to 33, in which a window for the camera is present in each waste-collecting channel.

35. An apparatus according to any one of claims 1 to 34, comprising a window for an illuminating means in each waste-collecting channel.

36. An apparatus according to any one of claims 1 to 35, in which the evaluated measurement results can be used to determine the weight of the separations.

37. An apparatus according to any one of claims 1 to 36, in which the evaluated measurement results can be used to determine the ratio of the proportion of good fibre to the proportion of dirt.

38. An apparatus according to any one of claims 1 to 37, in which the evaluated measurement results are used to determine the weight of specific types of dirt particles.

39. An apparatus according to any one of claims 1 to 38, in which limit values for the weight of the separated waste are provided.

40. An apparatus according to any of claims 1 to 39, in which limit values for the particulate content are provided.

41. An apparatus according to any one of claims 1 to 40, in which the arrangement is such that the evaluated measurement results can be used to assess the quality of the fibre material to be processed.

42. An apparatus according to any one of claims 1 to 41, in which the machine is connected to a central evaluating device to which more than one camera is attached.

43. An apparatus according to any one of claims 1 to 42, in which digital image processing can be used in the evaluating device.

44. An apparatus according to any one of claims 1 to 43, which comprises an electronic open-loop and closed-loop control device, having a memory for comparative data.

45. An apparatus according to any one of claims 1 to 44, in which the evaluating device is connected to a higher-level electronic monitoring system.
46. An apparatus according to any one of claims 1 to 45, in which the measured values of the camera are convertible to electrical signals.
47. An apparatus according to any one of claims 1 to 46, in which the evaluated measurement results can be used in an open-loop and closed-loop control circuit to optimise cleaning of the fibre material.
48. An apparatus according to any one of claims 1 to 47, in which images of the waste are taken by means of digitised photodiodes.
49. An apparatus according to any one of claims 1 to 48, in which evaluation of digital image information is effected by means of image analysis software.
50. An apparatus on a spinning preparatory machine, for example, a cleaner, opener, carding machine or similar, for detecting separated waste that emerges from separating elements and is collected in a collecting device, in which apparatus an optical measuring device that monitors the waste is provided, wherein an electronic camera which is connected to an electronic evaluating device (image-processing unit) is associated with the waste-collecting device.
51. An apparatus for detecting separated waste in a spinning preparatory machine, the apparatus being substantially as described herein with reference to and as illustrated by any one of Figs 1a, 1b, 2 to 6, 7a, 7b and 8.
52. A spinning preparatory machine comprising an

apparatus according to any one of claims 1 to 51.

53. A method of opening and cleaning fibre material, comprising transporting the fibre about two or more rollers in opening and cleaning relationship, separating waste from the fibre material at at least one separation gap, and examining the separated waste by means of a camera.

54. A method according to claim 53, which utilises an apparatus according to any one of claims 1 to 52.

55. A method according to claim 53 or claim 54 in which waste separation means is adjusted in dependence upon the results of examination of the waste.

INVESTOR IN PEOPLE

**Application No:** GB 0130611.7 **Examiner:** Alex Littlejohn
**Claims searched:** 1-55 **Date of search:** 12 March 2002

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# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): D1N

Int Cl (Ed.7): D01G; G01N

Other: Online: EPODOC, JAPIO, WPI

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | GB 2354011 A | (Trützschler) see whole document, e.g. abstract | - |
| A | GB 2316099 A | (Trützschler) see whole document, e.g. abstract | - |
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